2017 Test Beam Analysis

Joe Osborn

UMich

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Reminders

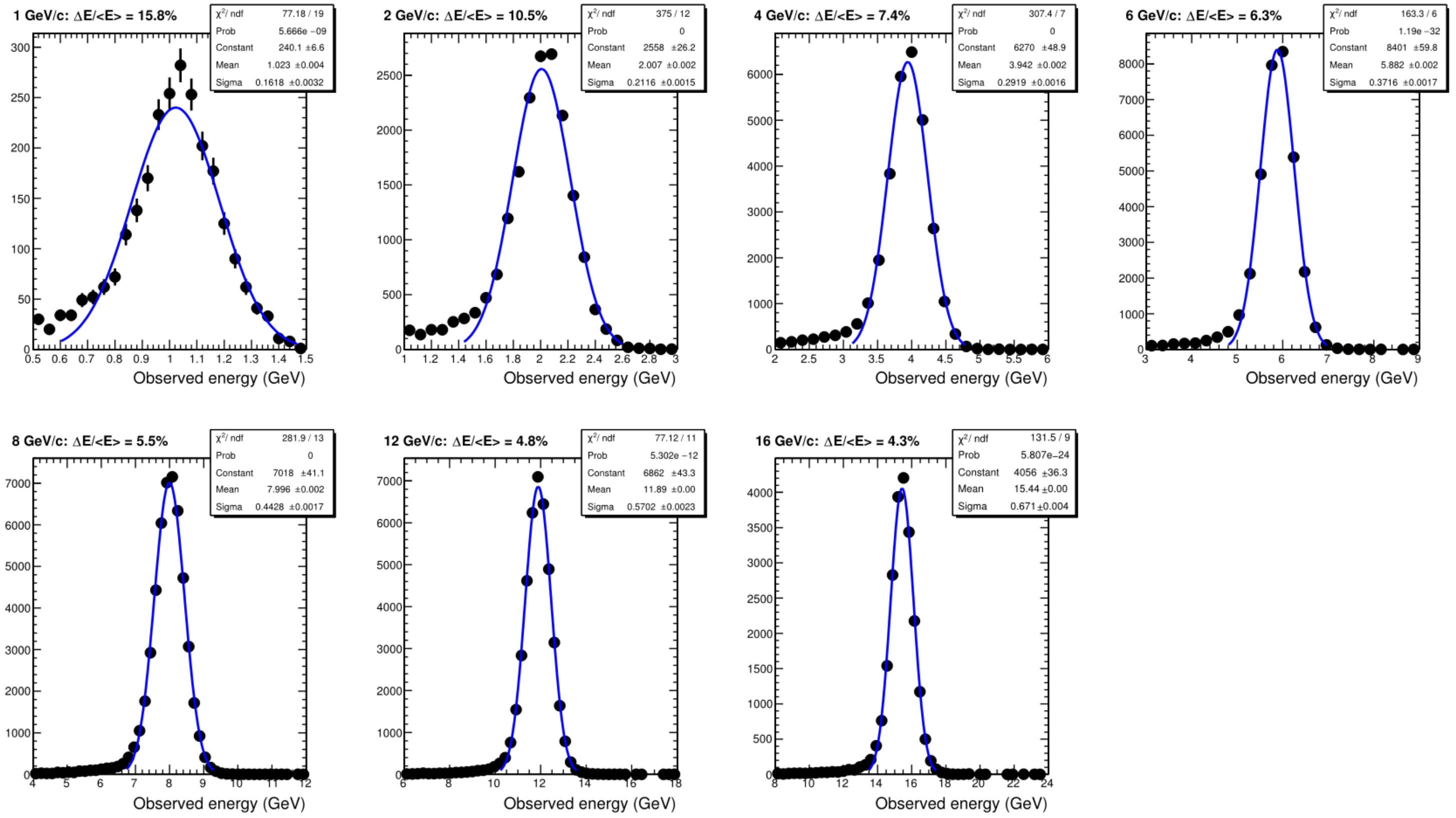
- Last presentation: February 21
- I have been working on the EMCal resolution in the 2017 test beam
- 2017 had particularly good data since we investigated the effect of the block boundaries
- First energy scan – block boundaries not included
- Third energy scan – block boundaries included
- After the hodoscope (position) dependent energy correction, we should be able to see the effect of the block boundaries on the nominal EMCal resolution

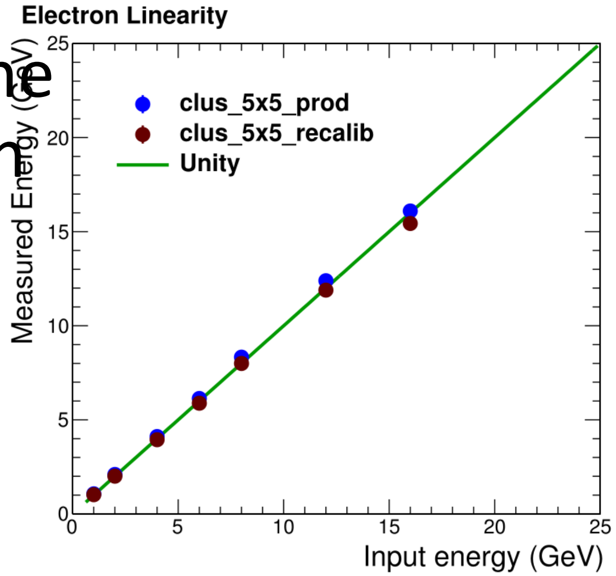
First Energy Scan

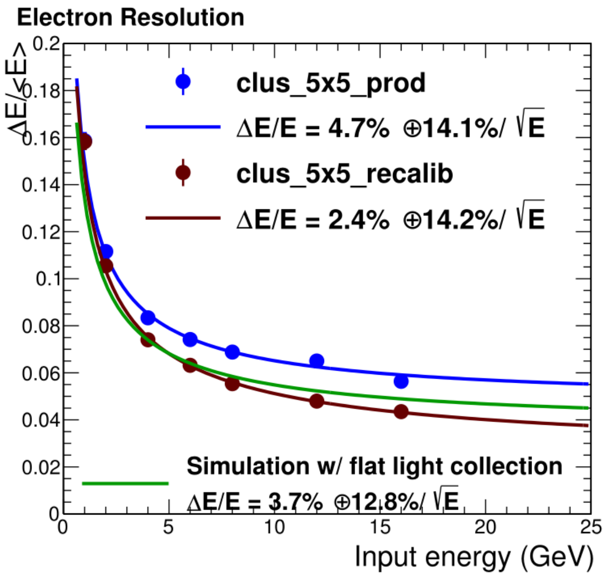
no block boundaries

First Scan Resolution (from last time)

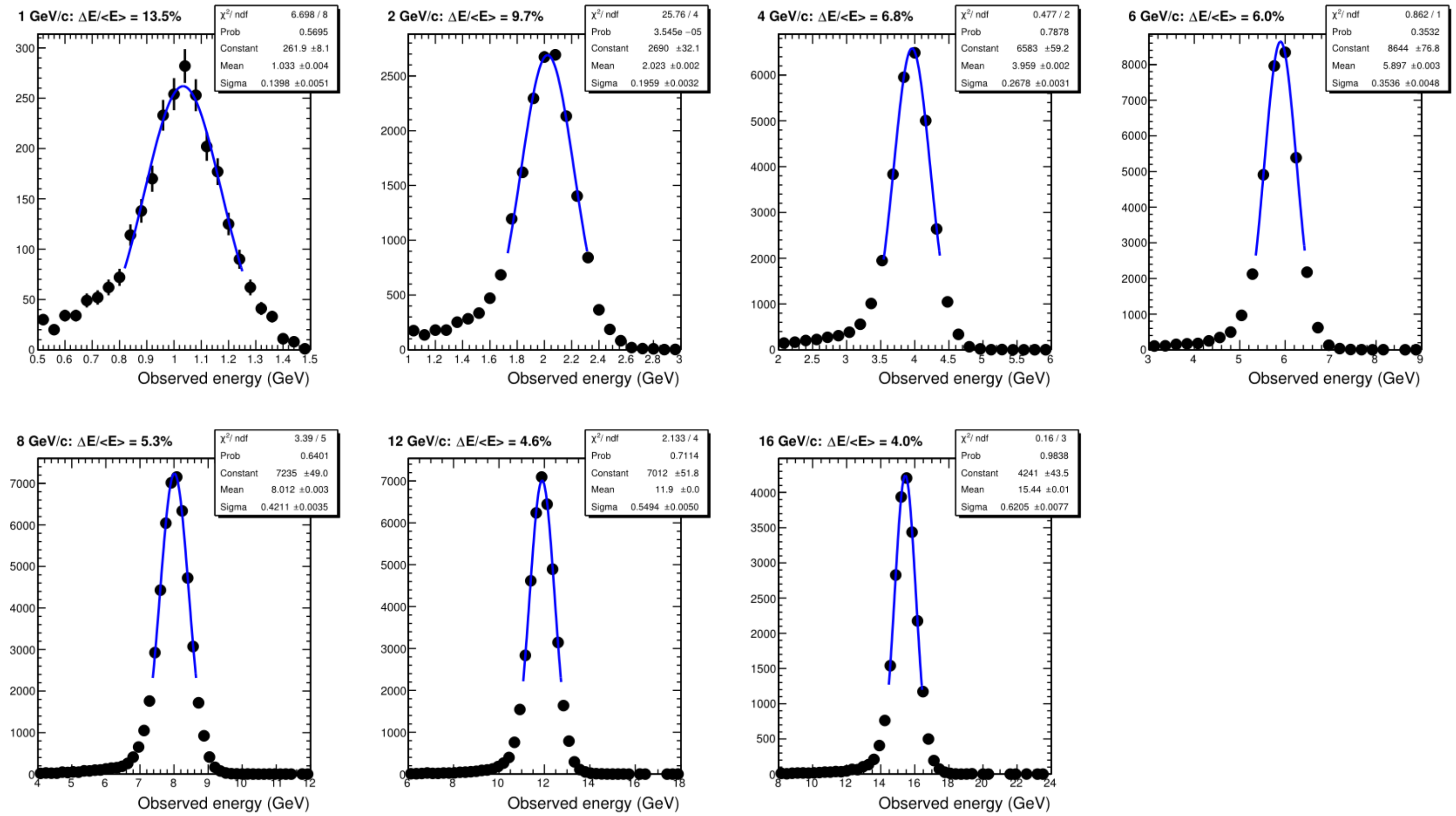
- Last time I showed nominal energy resolutions for both scans
- Note that fits are reasonable, but don’t entirely capture peak position
- Even in first scan there is some nonzero tail after the position dependent hodoscope correction

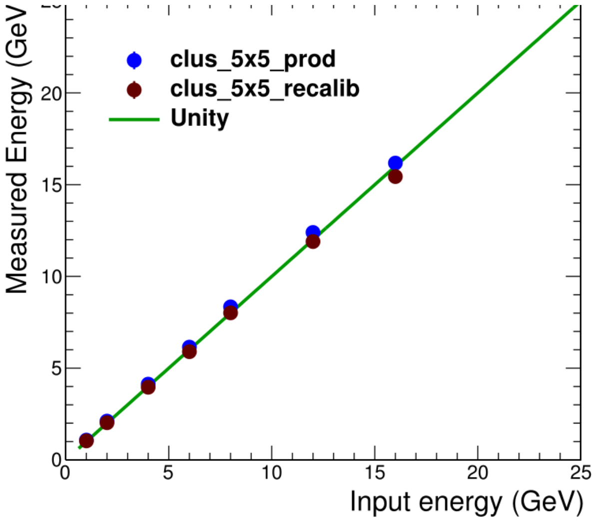


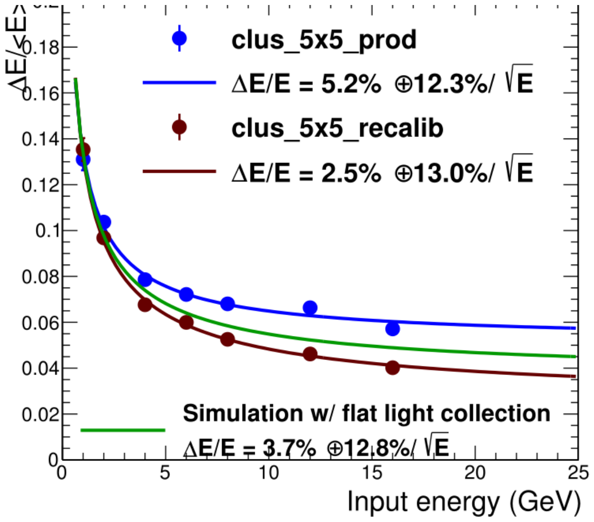




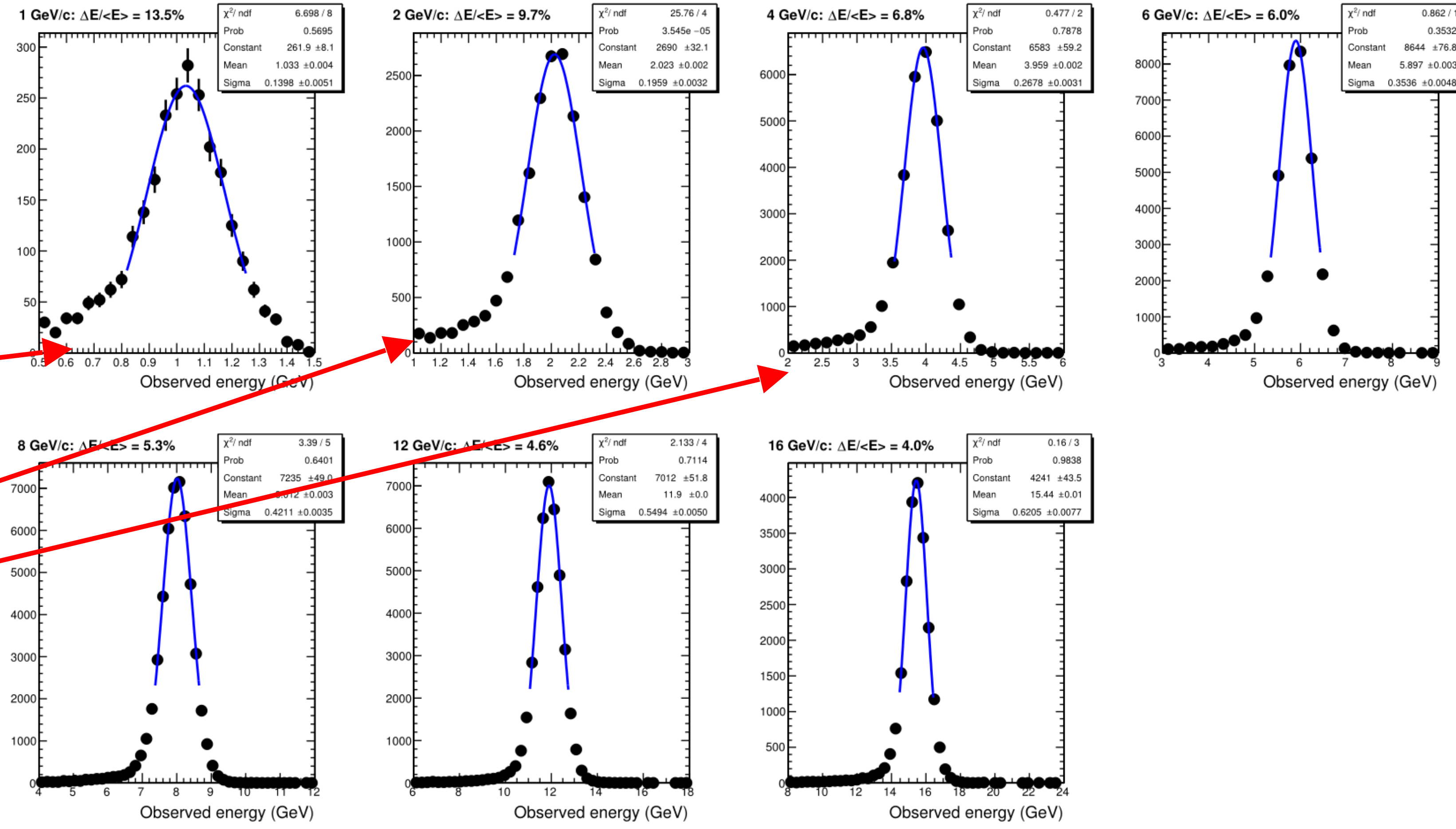
- If we reduce the fit range to better encapsulate the peaks, the resolution improves marginally
- Constant term is the same (2.5%)
- Stochastic term improves from 14.2% to 13%







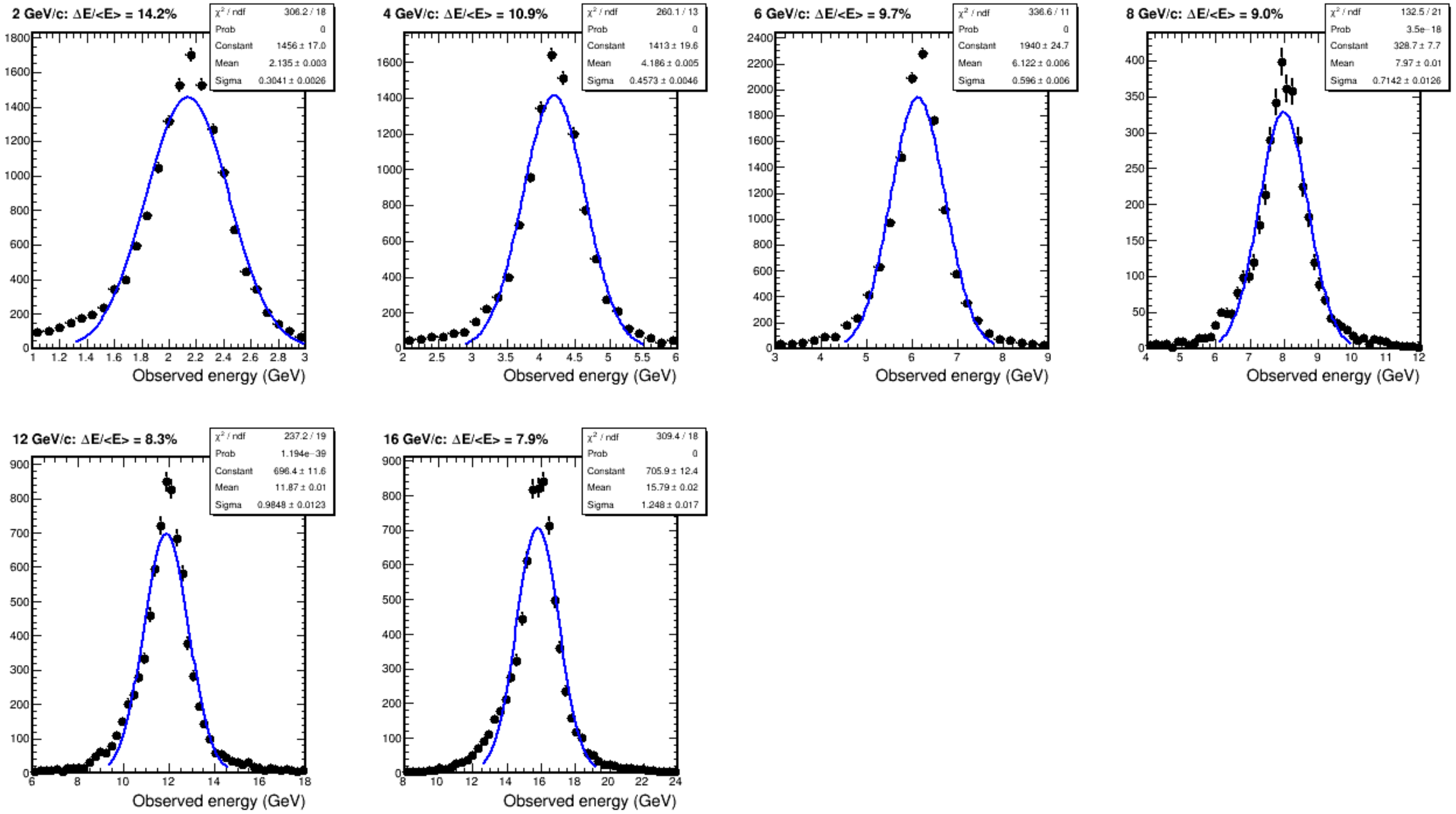
- Note that the distributions are still highly skewed though!
- Not so surprising, as you might expect you are more likely to get energy loss rather than energy gain



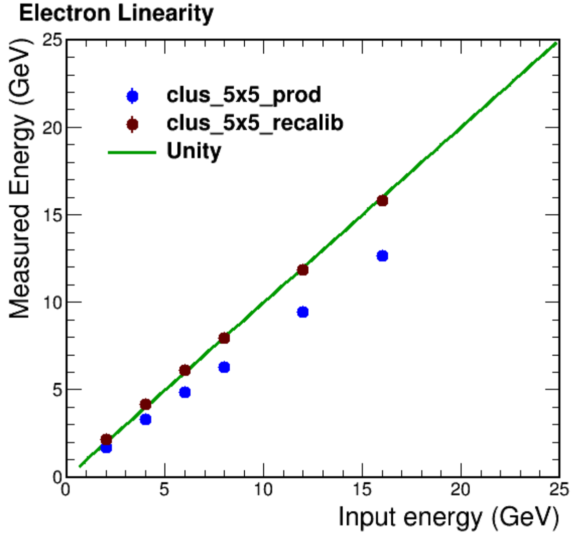
Third Energy Scan

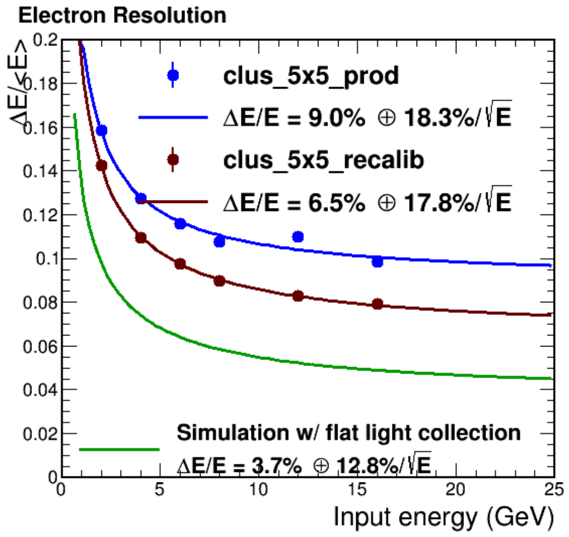
With block boundaries

Third Scan Resolution (from last time)

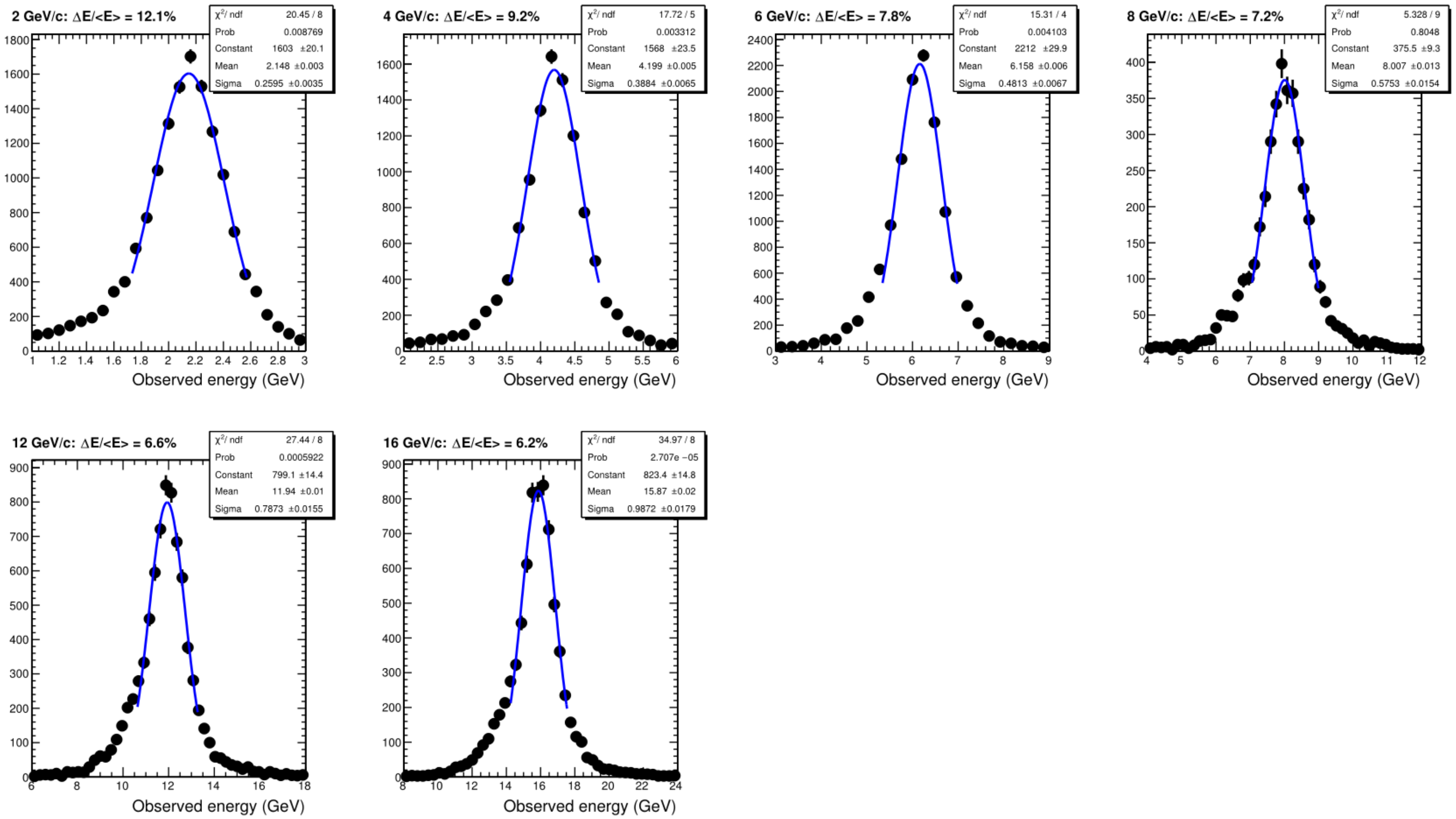


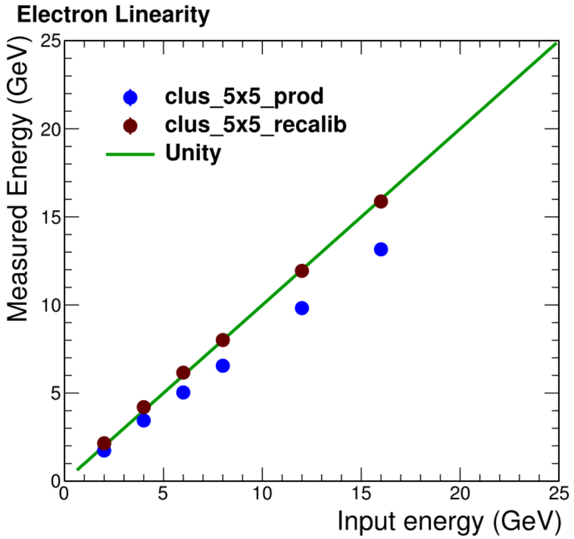
- Fits are noticeably worse
- Don’t encapsulate peak position well at all
- Resolution still improves, but still quite bad

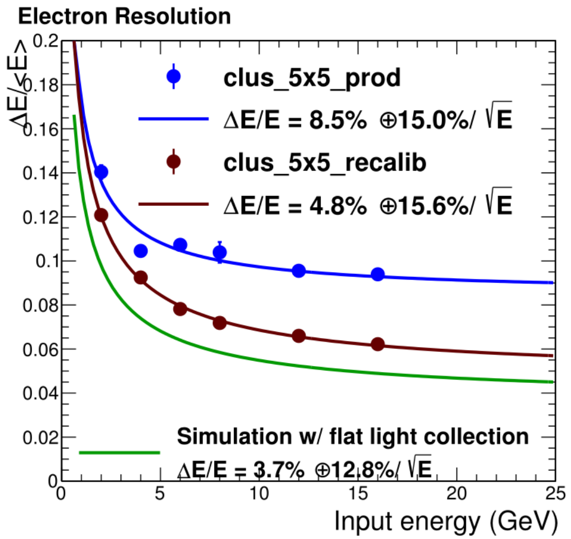




- If the fits are improved to better encapsulate the peak region, the resolution improves noticeably (duh)
- Constant term improves from 6.5% to 4.8%
- Stochastic term improves from 17.8% to 15.6%

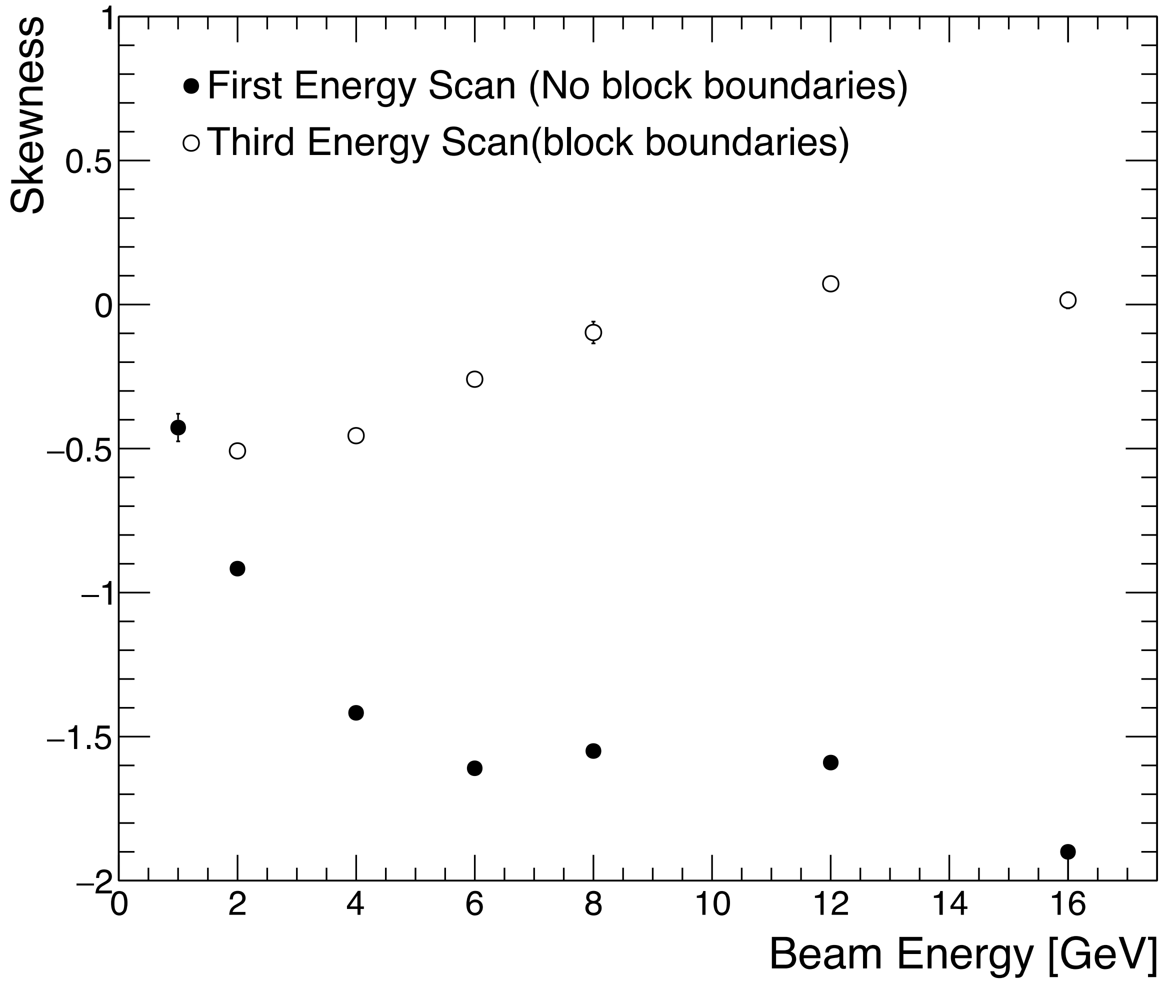






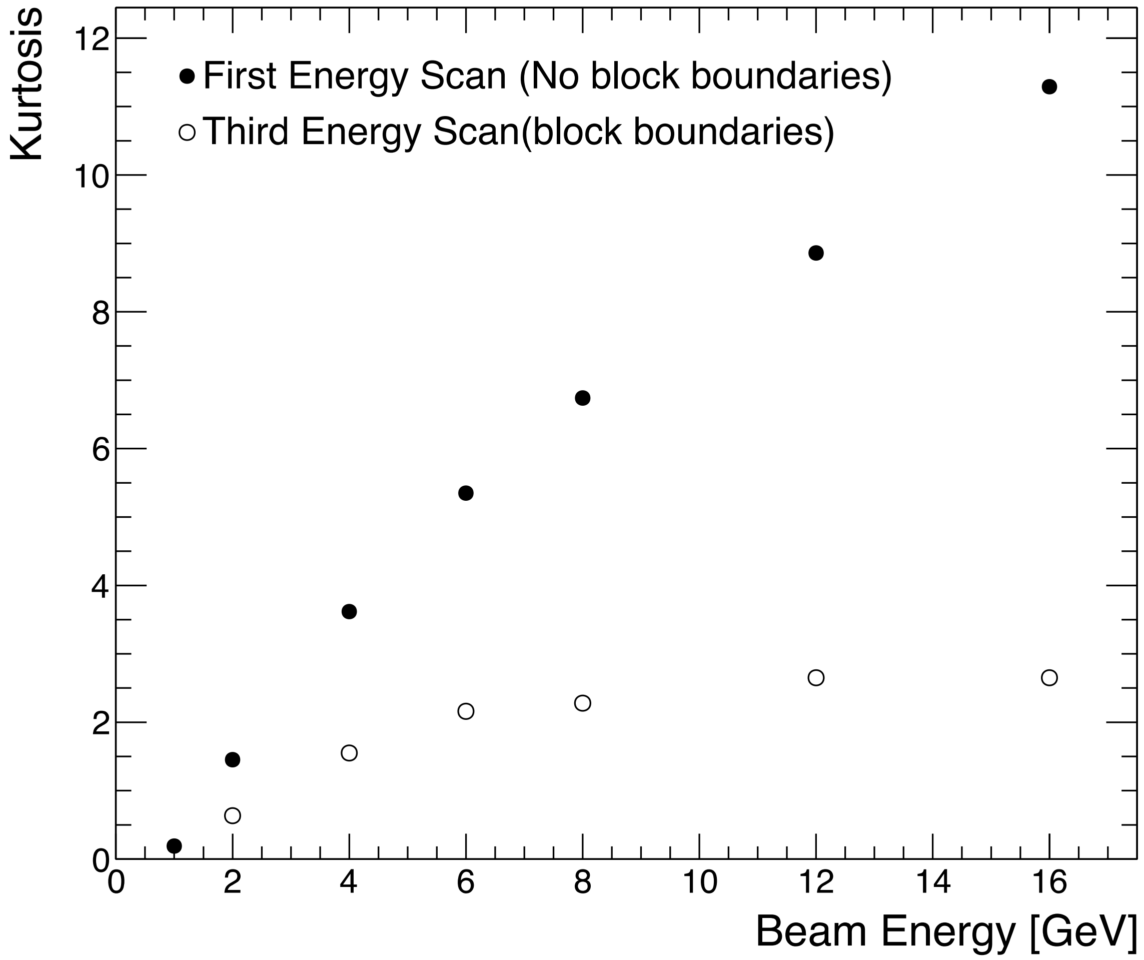
Characterizing the Distributions

- We can make plots of the skewness and kurtosis of the energy distributions in both the first and third scan
- Skewness: a measure of the asymmetry of a distribution
  - Negative skewness → tail on the left side of the distribution is longer or fatter than the right side
- So actually the first energy scan is more skewed (!), i.e. tail is is more prominent in first scan. We saw this by eye on pg 6
- This isn't the whole story though, because all this indicates is that you are more likely to mismeasure less energy than too large energy, which intuitively makes sense



Characterizing the Distributions

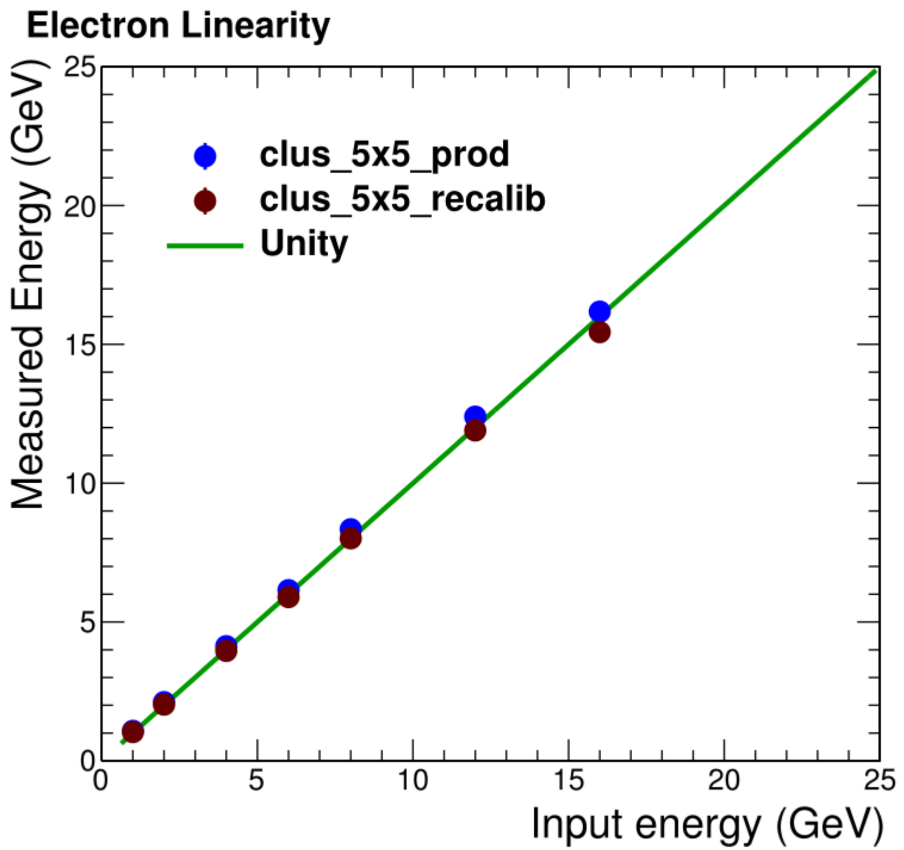
- We can also determine the kurtosis of the distribution
- From wikipedia: "higher kurtosis means more of the variance is the result of infrequent extreme deviations, as opposed to frequent modestly sized deviations"
- Normal distribution → kurtosis=3
- Platykurtic distribution → kurtosis<3 (central peak is broader and lower)
- Leptokurtic distribution → kurtosis>3 (central peak is higher and sharper)

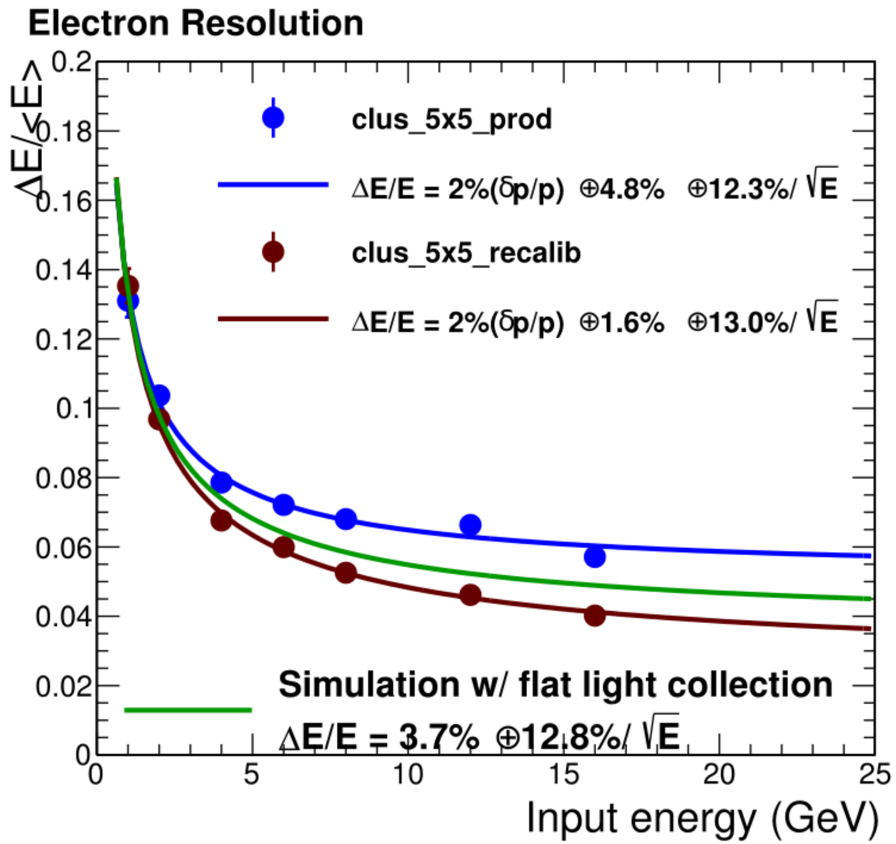


Conclusions

- Resolution of different scans improves when fits better approximate the peaks (obviously)
- Statistical measures of shapes of distributions gives us some quantitative description of the energy distributions after hodoscope recalibrations
- The kurtosis plot tells us what we need to know: the hodoscope correction works better without the block boundaries because the peaks are more centrally defined rather than more normally distributed like the third scan
    - In principle not that surprising, but this gives us a quantitative measure of how well the position dependent calibration works for the two energy scans
- Back up slides contain plots with the resolution excluding a 2% constant term like what was done in the 2016 test beam paper
    - This is just for documentation, Anne is putting these in the CDR

First Energy Scan





Third Energy Scan